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ABSTRACT

This survey was conducted to determine how state education agencies were addressing the issue of mathematics, science, and vocational education. Questions concerned (1) the current state of their vocational programs in relation to increased emphasis on mathematics and science for high school students; (2) presence or absence of a state policy that allows vocational education credit in lieu of or in cooperation with science or mathematics; and (3) development of related materials. All 41 respondents reported concern about the impact of increased basic skills requirements on vocational education enrollment, and 27 of the states responding were involved in major curriculum projects to assess the extent of "basic skills content" included or to be included in vocational education courses. Eleven states indicated that they had a policy that allowed vocational credit to be counted in lieu of science or mathematics. Sixteen states gave local school districts jurisdiction over course approval, while only three states prohibit such credit in lieu of a basic skills course. Vocational courses reported as appropriate in lieu of a basic skills course (provided such courses met state requirements for substitution) were representative of all vocational areas. The activity reported most often by states was piloting of a "Principles of Technology" course. Secondly, states were involved in a variety of projects to determine the extent to which mathematics and/or science content was present in current vocational programs, and an assessment of essential content to include. Research efforts were reported in the areas of improvements in vocational education, identification of courses that would fulfill graduation requirements in mathematics or science, and in formulating policies for granting such credit. (The report includes summaries of responses from each state.) (KC)

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ED259143

DEPARTMENT OF PUBLIC INSTRUCTION
INSTRUCTIONAL SERVICES BRANCH
VOCATIONAL EDUCATION DIVISION
DOVER, DELAWARE

APPLYING THE ACADEMICS:

A TASK FOR VOCATIONAL EDUCATION

JUNE 1985

U.S. DEPARTMENT OF EDUCATION
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FOREWORD

This report summarizes activities which were carried out to determine efforts of all states in relation to increased emphasis on basic skills courses, particularly in mathematics and science. Activities were designed to specifically review what, if any, efforts were undertaken to incorporate math and science into existing vocational education programs.

Another concern of the project was to identify those states which recognized vocational education courses as appropriate in lieu of or for credit in math or science areas. Curriculum or research projects which addressed the major concerns were also identified and are reported here.

Two activities were completed during 1984-85. The first, a computer search through ERIC (Educational Resources Information Center), asked for projects, studies and related experiences which had been conducted during the past five years. Secondly, a national survey of all State Directors of Vocational Education, or appropriate state staff, was completed with a seventy-eight percent response. This report summarizes that survey and presents related findings.

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The Need for Increased Attention on Vocational Education/Math/Science Integration

During 1984 and as a result of various task force reports, over 44 states increased graduation requirements for science, math and English. The impact of this decision on other content areas, particularly vocational education, has not been clearly defined.

A major concern has been to determine alternatives for those students not able to complete the "traditional route" to fulfilling graduation requirements and yet become skilled in job preparation through vocational education. The issue of Vocational Education's role in the recent "resurgence" of the "basics" has not been clearly identified, even though many of the more than 10 Education Task Reports have pointed out the need for greater application of basic skills.

Dr. Harry F. Silberman's recent comment in Professional News (1) that "--we must recognize that vocational education is the applied side of academics" is very significant as we review what states are doing about the issue of increased science and math requirements for high school graduation and the impact on vocational education programs.

Dr. Silberman also states that,

> "the Commission (on Secondary Vocational Education) recommends integrating academic and vocational studies so that all students will be able to choose from a comprehensive set of course offerings".

The need for students in vocational programs to be as capable of levels of performance in critical skill areas as students of equal ability who complete academic and general education programs has been disucssed extensively. The need for vocational programs to be more rigorous and include academics is stressed by Dr. Silberman. Admiral Hyman Rickover, reiterates this need in his Perspective comments in a July, 1983, News Journal (2),

> "--courses should emphasize the verbal and mathematical competence which is increasingly required of all working adults. For without such basic skills, graduated students, however vocationally well trained they may become in high school--cannot expect to be easily retrained".

Recent policy papers (3) stress the unique educational opportunity which integration between general education and vocational education can provide. Frank Pratzner states, "the first priority for secondary-level vocational education is to offer good education-in reading, writing, computing, listening, and problem solving. It has a responsibility for ensuring that youths are equipped with the basic skills needed for employment as well as for life".

Pratzner continues,

> "Given the magnitude and projected duration of the current economic recession, secondary-level vocational education should strengthen development of broadly applicable, fundamental skills (e.g., reading, writing, speaking, listening, computing, science, problem solving, critical thinking and decision making) that are likely to be needed for effective performance in a wide range of occupations--".

Again the issue is not whether secondary students should be prepared for jobs, nor is the issue whether secondary students should receive a general or a specialized education. All students need both kinds of preparation. It is not an either/or situation (4). This unique educational opportunity which integrates general education and vocational education needs to be explored (5).

Purpose and Results of the National Survey

This survey was conducted to determine how state education agencies were addressing the math, science and vocational education issue. Forty-one responses to a request for information "relating science and math to vocational education issues" are summarized as they apply to three major questions.

1. What is the current state of your vocational programs in relation to increased emphasis on math and science for high school students?
2. Does your state have a policy which allows vocational education credit in lieu of or in cooperation with science or math?
3. Have related materials been developed which aid in implementing any of the above?

Current Status

All respondents reported concern about the impact of increased basic skills requirements on vocational education enrollment or the possible inability of students to complete training for job competence. Decreasing enrollment was reported in only three states, however, the impact was noted as "too soon to know" in several responses.

Twenty-seven of the states responding were involved in major curriculum projects to assess the extent of "basic skills content" presently included in vocational education courses or in research related activities to identify content which should be a part.

State Policy

Eleven responses indicated that a state policy existed which allowed vocational credit to be counted in lieu of science or math. Sixteen states give local school districts jurisdiction over course credit approval. Only three states have a policy which prohibits credit allowance for occupational/vocational technical subjects as a substitute for mathematics, science or any other required subject.

A variety of questions are used to determine if a vocational course is appropriate in lieu of or for credit in math or science. They include:

- Does the course include sufficient amounts of math and/or science content?
- Does the course aid students in competency development in math or science areas?
- Is sufficient time spent on the specific content in math or science?

Vocational courses reported as appropriate in lieu of a basic skills course (if content and/or competencies meet state requirements for substitution)

were representative of all vocational program areas and types of secondary schools. Specific examples cited were:

Plant Science	Sheet Metal
Animal Science	Electronics
Computer Science	Drafting
Data Processing	Agricultural Production
Business Math	Horticulture
Technical Math	Forestry
Bookkeeping	Agricultural Resources
Health and Nutrition	Consumer Education
Accounting	Introduction to Computers
Business Economics	Commercial Foods
Business Law	Aircraft Mechanics
Health Services	Air Conditioning
Practical Nursing	Auto Mechanics
Cosmetology	Carpentry
Child Care Services	Diesel
Developmental Occup.	Electricity
Programs (Handicapped)	Machine Shops
Heredity and Child	Truck Mechanics
Development	Joint Academic/Vocational Programs

Vocational education, in some form, is a part of graduation requirements in nineteen states. For example, in Kentucky, students choose from a list of "approved vocational courses" to fulfill graduation requirements. In Maryland, in order to graduate, students must complete a course in Practical Arts (Home Economics, Industrial Arts, etc.).

Summary

The activity reported most often by states' respondents was piloting of a "Principles of Technology" course. States are involved in implementing this course which may meet the need for increased basics for some students. Secondly, states were involved in a variety of projects to determine the extent to which math and/or science content was present in current vocational programs, regardless of the type school. Usually this effort also included an assessment of essential content to include and to add if necessary.

Research efforts were reported in several areas: recommendations for state-wide improvements in vocational education; identification of courses which would fulfill graduation requirements in math or science; and in formulating policies for consideration at state and local levels. The area of greatest need seemed to be that of improving existing vocational programs in relation to increased emphasis on math and science content and on developing cooperative approaches to helping teachers with that task. Figure I presents an overview of states' responses to major items in the study.

Figure I, Summary of States' Responses to the Survey on Related Vocational Education, Math and Science Activities and Concerns.

SURVEY ITEM	RESPONSES (N=41)
1. Vocational Education is a part of state's graduation requirements. (7)	19
2. Local school districts may determine appropriateness of course for graduation credit.	16
3. State prohibits Occupational/Vocational credit for required courses.	3
4. State is concerned about impact of increased graduation requirements on vocational enrollment.	41
5. State allows vocational credit "in lieu of " math and science credit.	11
6. Related curriculum/research activities in progress.	27

States' Responses

Reports of each state's activities are summarized as follows:

In Delaware

Through coordination of the State Director of Vocational Education, supervisors of the Delaware Department of Public Instruction and a Public Service Fellow from the University of Delaware, four major activities have been carried out during 1984 and early 1985 which relate to the issue of math and science in the vocational curriculum. First, an informal survey, conducted by the staff of the Vocational Division, of the five vocational-technical schools, asked for identification of related math and/or science content included in each program. A copy of the survey form can be found in the Appendix.

Secondly, after a search of projects and activities through ERIC was conducted to aid in identifying model approaches for assessing related content and for determining essential content in math and science, vocational and academic content, supervisors and teachers developed a model vocational curriculum for masonry utilizing math and science components. A national survey on which this report is based, was completed early in 1985 and is providing suggestions and implications for Delaware program planning in vocational education.

A fourth activity has been to structure and pilot a "model workshop" for cooperatively identifying and incorporating essential math and/or science content and standards into existing masonry program standards.

Delaware also has a state policy which states, "credit allowance applied to occupational/vocational technical subjects shall not be used as a substitute for mathematics, science, or any other required subjects, even though aspects of mathematics, science and other subjects may be included as part of the instructional program" -- related instruction, however, may be provided at the vocational-technical school with appropriate credit granted beyond the basic one unit requirement. Local districts do allow credit in some areas such as Agricultural Science and Business Math.

In Other States

Alabama

Many vocational programs are experiencing some decrease in enrollment due to increased emphasis on science and math; some local school districts have a policy which allows vocational education credit in lieu of science or math; is currently piloting programs that would provide vocational credit in cooperation with science and math.

California

Vocational programs in comprehensive high schools are suffering due to increased graduate requirements; is in the process of developing procedures for trying to implement acceptance of vocational courses for math and science.

Colorado

Increased emphasis on math, science, reading and computer technology; some vocational education courses are being approved by local boards of education as science courses.

Connecticut

State law specifies one credit in the arts or vocational education; such courses as business math, technical math, bookkeeping, computer programing and computer science may be counted toward requirements if mathematical in nature; content of program is key to acceptance as science course whether home economics, industrial arts, etc.; some health occupations courses might result in credit for science if content is appropriate; examples of Home Economics courses which meet science requirements are: Heredity and Child Development and Health and Nutrition.

District of Columbia

Preliminary plan has been developed for integrating science and mathematics into all vocational education programs; has presented a recommendation to the Board of Education that shared-time students earn one of the two required Carnegie Units in math and science, for applied/trade related classwork; basic skills integration program plan includes use of a resource teacher to work closely with teachers in the developing and teaching of basic skills related to the trade.

Florida

Law allows the limited substitution of vocational credit for regular math and science credit but not to exceed one credit in each area; student must complete a vocational program to receive credit; course in Life Management Skills (Home Economics or Health) is graduation requirement.

Georgia

Has developed math materials to be used in twelve vocational subject areas.

Hawaii

Small rural schools have suffered most due to new emphasis on basics; courses such as Electronics can be used for the second science requirement.

Idaho

Field-testing Principles of Technology material which will, hopefully, be adopted as a science course to meet academic requirements; in order for a course to count as a high school credit, the teacher must have fifteen hours of coursework on the teaching certificate (i.e. math, science); task force report recommends for vocational education that: 1) practical arts be added to Humanities requirement description; 2) local districts be allowed to collectively assess and identify competencies, that, when demonstrated by students at a minimum level, can be used to fulfill course requirements.

Illinois

A state policy allows vocational education courses to count for credit in selected academic areas; has a second option for achieving compliance with the new graduation requirements--if a student is in a vocational education program taking math, accounting, computer science, industrial arts, math, such as drafting--the policy allows the flexibility that these courses fall under the math requirement if the basic core of the courses are math oriented; local school districts may identify and describe courses--that contain a basic core of instructional activity deemed applicable for graduation requirement in a "related subject area".

Indiana

Is involved in activities that emphasize the importance of math, science and language arts in vocational education through staff activities and funded projects; funding has been provided for special projects examining the math and language arts content in vocational education courses, and developing curriculum products to use in related projects.

Kentucky

Twelve of twenty credits required for high school graduation must be in basic skills, however, one unit "will be from math, science, social studies or language arts or one of the vocational courses identified in the Program of Studies for Kentucky Schools, Grades K-12"; appropriate courses are identified in all vocational program areas which meet requirements. Is implementing **JAVA**, (Joint Academic Vocational Approach) Curriculum plan.

Louisiana

Vocational teachers are integrating basic science and math concepts in their instructional programs; science and math concepts have been integrated into the curriculum guides used in vocational education.

Maryland

Has strong local control; four local school systems allow some vocational credit in lieu of math or science; is utilizing many resources, such as ILS modules (Oregon) to upgrade curriculum.

Massachusetts

Tradition in Massachusetts includes the requirement that state approved vocational education programs include related instruction which is usually math and/or science as applied to the specific vocational subjects; efforts are underway to develop related materials for training vocational teachers in math and science fields.

Michigan

Has developed a "Blueprint for Action" which follows national research on excellence in education; some local school districts have reviewed their vocational programs to see if science and math are compatible with the requirements; materials are developed which allow access to the general education development of occupations.

Minnesota

Many local districts have recognized relatedness of math/science/vocational education and do allow recognized credit for some courses.

Missouri

Recent study of vocational education indicates a recommendation that credit should be allowed for those vocational classes, which provide substantially the same competencies as other specified courses, to meet increased graduation requirements; districts can substitute Plant Science and Animal Science for the science requirement; is implementing a Vocational Instructional Management System (VIMS); will identify math and science concepts included when standardized curricula from academic areas are available.

Montana

Increased emphasis upon academics has not adversely affected the offerings or enrollments of vocational education at high school level.

Nebraska

Is participating in Principles of Technology project; has a state law that identifies vocational education as one of the core curriculum subjects from which local graduation requirements will be established.

Nevada

The state is currently working on a secondary course of study that would suggest to local school districts that they allow certain vocational classes, which may incorporate math and science in their curriculum, to count as credit toward graduation.

New Jersey

Application of science, physics and math has been an integral part of vocational program instruction in T&I Education courses; generally, credits are assigned for each vocational course offered in the public schools, for science and math, if the course outline clearly indicates that instruction in science and math is identified.

New Mexico

Is developing vocational technical education competencies stressing the attainment or reinforcement of the basics which include many in the math and science areas.

New York

Is completely revising occupational curriculum, making related math and science a portion of that curricular revision; regulations recognize occupational

related math and science for students enrolled in an occupational program; a unit of credit earned in occupational related science may automatically satisfy both an occupational credit requirement and diploma requirement; currently developing a state curriculum in occupational related math and science; also working on models of instruction which would identify how programs could be offered at area occupational centers.

North Dakota

Is participating in Principles of Technology; has experimental program in Machine Shop that has developed related math instruction - credit can be substituted for second math requirement.

Ohio

Blue Ribbon Study Committee is considering impact of more academics nationally; will be providing more flexibility in scheduling options to permit more opportunity for students to gain academic credit; research study underway to analyze feasibility of permitting vocational teachers of two types of disadvantaged programs to teach very basic academics for credit in a self-contained classroom; will continue to supplement the academics within the block time; vocational program recommendations are included in Program Options Proposal (draft).

Oklahoma

The following was adopted by the State Board of Education at its meeting on July 28, 1983:

> "A school may waive a unit of credit in mathematics and a unit of credit in science providing a student completes six (6) vocational units of credit in vocational agriculture or vocational home economics. A unit of credit in either mathematics or science may be waived, providing a student completes at least three (3) vocational units of credit in either vocational agriculture or vocational home economics."

Oregon

State Policy relates vocational education as a contributor to achievement in both math and science, but not dealing with credit; local districts have option of doing what they like about using vocational education in lieu of science and math--an increasing number of districts are studying expected student outcomes in both subjects and matching them with outcomes in vocational education and related math/science; has developed guides in math, speaking and listening, writing, and reading which help vocational instructors enhance the teaching of these.

Puerto Rico

Has prepared a teacher's guide for Vocational Math applied to the occupations; has incorporated micro-computer project BEST (Basic Education Skills through Technology) and MSCP (Model School Computer Project) into seven schools.

South Carolina

State Department of Education is allowing vocational programs to be restructured to allow local school districts to meet demand for additional math and science requirements (through experimental programs); one unit in computer science or data processing may be counted toward math requirement; students who earn one credit in science and six or more in a specific occupational service area can meet the science requirement for a state high school diploma; an applied Vocational Math Curriculum Guide was developed--Vocational students can receive one unit of math credit if enrolled in an applied vocational math course.

South Dakota

Has task force addressing some of the topics.

Tennessee

Expects an impact on scheduling two and three hour blocks of Vocational Education programs; plans are to provide more flexibility in allowing some one and two hour blocks in lieu of all three hour blocks; some math materials developed which relate to vocational subjects and designed to improve math proficiency scores (modules for use in Building trades, Drafting, General Metals, Auto Mechanics, Home Economics, Office Occupations, Cosmetology, Agriculture and Health Occupations).

Utah

The effect of increased emphasis on math and science has resulted in about a two percent drop in 11-12 grade vocational enrollment, anticipation is that enrollments will actually increase in grades 9-10 because a vocational core course is required during grades 9-12; base core skills are being identified and will become a part of the vocational curriculum; is part of the ATE consortium (Principles of Technology) to develop and implement a class with high level of math and technical content; is preparing lists of competencies to be attained in occupational preparation classes and ways to measure attainment of these competencies; state policy is under consideration.

Vermont

A state policy notes that some vocational technical programs may offer the equivalent of one-half or more years of study in areas required for graduation; project is underway to determine the math, science, English, language arts, social studies and arts components included in eighteen vocational technical program curriculums--any program areas that contains at least one-half year of study in one or more of the required graduation areas will be further developed with competencies and identification of the appropriate vocational program content.

Virginia

A state policy which provides an alternative to the requirement of a math or science course to complete a twenty credit diploma program, states "...this requirement may be met by completing the sequence of courses for occupational preparation in one of the programs in Agriculture, Business, Health Occupations, Occupational Home Economics and Trade and Industrial Education"; has developed Occupational Preparation Program Options handbook for implementing policy.

Washington

Has enacted recent legislation that states "local school districts shall consider the relevance of vocational and applied courses in fulfilling high school requirements for graduation"; brochure has been developed titled "Basic Skills in Vocational Education".

Wisconsin

Has graduation requirement that allows for granting of cross-disciplinary credit providing that the generic subject matter can be adequately illustrated; is involved in a major initiative relating to "Education for Employment".

Wyoming

Local school districts have jurisdiction in allowing vocational education credit in lieu of science and/or math.

Conclusions and Recommendations

This national survey identified related concerns of all respondents about math/science/vocational education issues. Conclusions and recommendations have been developed, for review, with implications for Delaware as well as for other states.

The survey provided information which reinforces:

- The need to complement graduation requirements through vocational education's increased attention to math and science content.
- Greater flexibility in vocational education programs in format and time blocks.
- Closer linkages with educators responsible for academic standards and content.

1. In many states, as well as in Delaware, local school districts have a major role in determining courses which may be appropriate in lieu of or for credit in required areas for graduation.

It is Recommended That:

A resolution or policy be considered which emphasizes the need for all local school districts to assess the math and science content and/or competencies of all vocational courses and programs in consideration of possible credit allowances.

It is Also Recommended That:

The current state policy which prohibits credit allowance applied to occupational/vocational technical subjects be reviewed and consideration be given to an appropriate resolution or policy that establishes conditions or standards that would allow credit in circumstances that warrant same.

2. A greater responsiveness, of vocational teachers, to students' needs for increased science, mathematical and problem solving skills is stressed by a large majority of state responses.

It is Recommended That Appropriate Educational Agencies and/or the Educational Community-at-Large:

Support approaches for identifying essential math and science content and related

performance indicators through workshop activities with all teachers in vocational programs during 1985-86.

3. Math and science content are essential components for all vocational education programs and must be a major part of curricula, as evidenced by the efforts of twenty-eight states.

It is Recommended That:

The "Draft" Delaware Content Standards for Vocational Education programs be revised by adding essential math and science content, standards, and performance indicators prior to State Board approval.

4. Employability skills and academic skills are as essential for the entry level worker directly out of high school as for the college bound, according to national task force reports and leading vocational educators.

It is Recommended That:

Content for employability skills and standards be developed as major components of all Delaware Content Standards prior to the State Board approval.

It is Also Recommended That:

The final Delaware Content Standards for Vocational Education, with revisions in math, science and employability skills and as approved by the State Board, be utilized for major program improvement during 1986-87.

5. Increased graduation requirements in math, science and other basic skills courses may have a detrimental impact on some students in vocational courses structured in two and three hour blocks, over a three year period, as noted in survey responses.

It is Recommended That Appropriate Educational Agencies:

Assess the need for alternative programs which do not require two-three hour blocks of time, over a three year period, in order for vocational education to be accessible to all students.

6. Some vocational courses are appropriate for credit in lieu of or in cooperation with math or science courses, according to over two-thirds of the respondents.

It is Recommended That:

A procedure be developed for assessing the appropriateness of vocational courses for graduation credit in lieu of or in cooperation with math or science courses.

7. The concern for vocational program enrollment is at a high level nationally, as evidenced by comments of all state agency personnel.

It is Recommended That Appropriate Educational Agencies:

Support a state-wide assessment of enrollment trends in vocational education programs with proposed recommendations for improvement, if data indicates problems due to increased graduation requirements in basic skills courses.

8. Many reports and articles emphasize the critical need for young adults to master the basic educational skills and work habits required to achieve employ-ability, whether college bound or not, and to attain more specific vocational skills and experiences.

It is Recommended That:

Greater cooperation between general and vocational education teachers and administrators be supported as a priority for program improvement.

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APPENDIX

MATH/SCIENCE TAUGHT IN VOCATIONAL TECHNICAL PROGRAMS

SCHOOL _____ _____

DISTRICT _____

COURSE TITLE _____
(As approved by DPI)
CIP NO. _____

MATH SCIENCE
(Circle one)
Year II
Page ___ of ____.

NO.	TASK		APPLICATION		HOURS INVOLVED

NO.	TASK	APPLICATION	HOURS INVOLVED